

CHAPTER 1

INTRODUCTION

1.1 Research background

Wire Electro Discharge Machining (WEDM) is one of the applications of EDM. This machine is generally uses a thin brass wire as the electrode, making it possible to cut most shapes and contour from flat plate material. WEDM can do things older technologies cannot do as well, as quickly as, as inexpensively, and as accurately. Most parts can now be programmed and produced as a solid, rather than in sections and then assembled as a unit, as was necessary previously. WEDM is capable of producing complex shapes such as tapers, involutes, parabolas and ellipses. WEDM utilizes a thin, continuously moving wire as an electrode as in Figure 1. The wire electrode is drawn from a supply reel and collected on a take-up reel. This continuously delivers fresh wire to the work area. The wire is guided by sapphire or diamond guides and kept straight by high tension, which is important to avoid tapering of the cut surface. High-frequency dc pulses are delivered to wire and workpiece, causing spark discharges in the narrow gap between the two. A stream of dielectric fluid is directed, usually coaxially with the wire, to flood the gap between the wire and the workpiece. The power supply for the WEDM are essentially the same as for conventional EDM, except the current carrying capacity of the wire limits currents to less than 20A, with 10A or less being most normal. In addition, the spark frequencies are higher, up to 1MHz, to give a fine surface on the workpiece [1,2].

AISI 4140 Steel also known as chromium molybdenum alloy steel is oil hardening steel of relatively high hardening ability and is among the most widely used versatile machinery steels. The AISI 4140 Steel is a structural material with a relatively high hardening ability, good hardness penetration and imparts uniformity of hardness and high strength. AISI 4140 Steel are one of the most capable material selections for versatile machinery steels as it is comparatively easy to machine in the heat treated condition. It is usually used to make shafts, gears, bolts, couplings, spindles, tool holders, hydraulic machinery shafts, oil industry drill collars, and tools joints [22].

The SEM is particularly useful in material analysis for the examination of fractured surfaces of metals. SEM fractograph are used to determine whether a fractured surface is intergranular, transgranular, or a mixture of both. The SEM is the most widely used from of electron microscope in the field of the materials sciences. More than 10,000 SEMs are installed worldwide and two new instruments are delivered each day. The SEM is popular because it uniquely combines some of the simplicity and ease of specimen preparation of the optical microscope with much of the performance capability and flexibility of the more expensive and complex transmission electron microscope.

1.2 Scope of study

This project concentrates on the surface texture of the material used that is AISI 4140 Steel after it has been cut using WEDM. The characteristics of the material such as the surface structure and surface texture can be seen from the Scanning Electron Microscope (SEM) directly. The surface textures vary with different levels of the main machining parameters.

1.3 Problem statement

WEDM process is a violent thermal process where literally thousands of electrical discharges are produced in a fraction of a second in order to erode a certain volume of metal. However, the process generates surfaces that have poor properties such as formation of a recast white layer, which is very hard and contains many imperfections such as cracks and micro cracks. These properties vary with different levels of the main machining parameters such as pulse current, pulse duration and the speed of the wire. The most appropriate machining parameters have to be determined to make sure that it will produce good surface textures.

1.4 Objectives

- To investigate the main machining parameter in WEDM such as pulse-on duration and pulsed duration.
- To quantify the effect of machining parameters on surface textures after being machined by WEDM.
- To determine the relationship between machining parameters and surface roughness, micro-cracks and micro-voids on the machined surface.